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MEMORANDUM FOR PRS (In-House/Contractor Publication)

FROM: PROI (STINFO) 14 May 2002

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2002-111**
Frank Gulczinski (PRSS) and John Schilling (W.E.), "Comparison of Orbit Transfer Vehicle Concepts Utilizing Mid-Term Power and Propulsion Options"

28th International Electric Propulsion Conference **(Statement A)**
(Toulouse, France, 17-21 March 2003) (Deadline: 14 June 2002)

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16 Sep 02

Comparison of Orbit Transfer Vehicle Concepts Utilizing Mid-Term Power and Propulsion Options

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ABSTRACT

The recent announcement of a national nuclear space flight initiative[1] has rekindled interest in nuclear propulsion options within the spacecraft propulsion community. Therefore, the Air Force Research Laboratory Propulsion Directorate (AFRL/PRSS) has decided to reexamine the value of utilizing nuclear propulsion for orbit transit and the repositioning of future Air Force space assets. A trade study was conducted with the assumption that technologies had matured to the 2010 level. A comparison was made between advanced chemical, solar thermal, solar electric, and nuclear electric for both expendable and reusable mission concepts, with a particular interest in options that resulted in trip times of 30 days or less. Results show that for expendable stages both solar thermal and, to a greater degree, solar electric propulsion systems can provide a significant increase in payload delivered from LEO to GEO within the required trip times. The solar electric concepts utilize clustered Hall thrusters, thin film photovoltaic solar arrays for power generation, and advanced power processing topologies for power conversion. The nuclear electric option became advantageous for trip times greater than 30 days. For reusable vehicles, where payload and fuel are supplied to a reusable propulsion tug module, similar results were calculated based on trip time. However, with a reusable stage, other considerations related to component degradation in the space environment must be considered. This consideration results in a rapid degradation of the thin film arrays used for solar electric stages due to Van Allen belt radiation, whereas the reactors utilized for the nuclear electric options are hardened to prevent radiation damage to payload and thus are protected from the natural space environment. Thus, for a reusable orbit transfer vehicle, a nuclear electric tug becomes an attractive option for repositioning and transiting Air Force space assets.

[1] David, L., "NASA To Go Nuclear; Spaceflight Initiative Approved," Space.com, www.space.com/news/nasa_nuclear_020205.html, February 5, 2002.